Employment and Immigration Canada

Emploi et Immigration Canada

John Roberts, Minister

John Roberts, Ministre

Background Paper 31

MEASURES TO INCREASE POSTGRADUATE RESEARCH AND TRAINING THROUGH INDUSTRY INVOLVEMENT

Skill Development Leave Task Force

Background Paper

Canada

Employment and Immigration Canada
John Roberts, Minister

Emploi et Immigration Canada
John Roberts, Ministre

Background Paper 31

MEASURES TO INCREASE POSTGRADUATE RESEARCH AND TRAINING THROUGH INDUSTRY INVOLVEMENT

Skill Development Leave Task Force

Background Paper

Canada

Background Paper 31

MEASURES TO INCREASE POSTGRADUATE RESEARCH AND TRAINING THROUGH INDUSTRY INVOLVEMENT

University Branch, MOSST

January 7, 1983

This is one in a series of background papers prepared for the Task Force on Skill Development Leave. The opinions expressed are those of the author(s) and do not necessarily reflect the views of the Task Force or the Department of Employment and Immigration.

Control No. WH1-093E

OBJECT

To develop approaches for encouraging increased industry involvement in the support of graduate research and training.

PROBLEMS

The universities are hard-pressed financially, and in terms of research capacity, to respond fully to the challenges being posed by structural shifts in our economy, the shift in national priorities towards high technology growth industries, and the attendant demand for highly qualified manpower and research support for these industries.

It is evident that the government and the provincial educational authorities are limited in their ability to identify in a precise way the fields of technology, the manpower requirements, and the research priorities and capacity that is needed to adequately respond to these challenges. In many fields of advanced technology the leading edge of research is in industry, not at the universities (e.g. microelectronics); whereas in other fields, the universities have the scientific expertise, but not a pragmatic industrial orientation (e.g. biotechnology). For these reasons, government would be well-advised to promote close linkages between the universities and industries in a manner which is supportive, but not prescriptive.

The faculty and researcher supply situation is

particularly acute in three major areas:

- computer science;
- engineering; and
- management studies.

The situation in each of these areas has been documented by major studies. In the case of computer science, a report by the Canadian Computer Science Chairman (January 1982) reviewed the faculty, equipment and facilities shortages in the U.S. and Canada, (there is an international market for highly qualified manpower in very specialized fields). It was noted that the total production of Ph.D.s in computer science amounted to 250 (19 in Canada) in 1979 as compared to 1,300 positions seeking Ph.D.s. Fewer than 100 Ph.D.s sought academic positions as compared with 650 positions known to be open. Undergraduate enrolment has doubled since 1975 with only nominal increases in laboratory space, faculty and equipment. Academic salaries generally are not competitive with industrial offers, and Canadian academic salaries are about 36% below U.S. academic salaries.

The Canadian Deans have called for supplements to existing teaching resources; improved research funding; increased Ph.D. production; increased academic salaries; and relaxed immigration regulations for qualified non-Canadians. In particular, the Federal government has been asked to increase funds for research in computer science at universities, and to increase the number and value of graduate fellowships and research

assistantships. Provincial governments have been asked to provide more funds for space, facilities, equipment, and support for computer science. Industry and business have been called upon to increase their financial contributions to the universities for the teaching and research needs of computer science departments; to increase industry/university cooperation in joint projects and contract research; to encourage and financially support their employees wishing to undertake graduate studies in computer science; and to encourage and financially support students enrolled on a part-time basis.

Similar studies have been done for the faculties of management studies, and for the engineering schools. In the case of the engineers, a conference is being arranged by the CCPE and the Science Council of Canada in April 1983 to fully document the condition of engineering education in Canada, and to define an action plan to address these problems. It will call for a commitment from industry, government, education and the profession to help solve the problems identified.

In the U.S.A., where precisely similar situations prevail in the same fields of study, there are a number of initiatives taking place, mainly at the instigation of concerned university and industrial leaders and the various professional associations. This paper will review some of these initiatives for possible parallels with the Canadian situation.

This paper presents several models for the

promotion of greater industrial participation in university S&T based on recent developments abroad, mainly in the United States, and proposals that have been developed in Canada. These models are not mutually exclusive - most could proceed independently of government support - but the existence of government support would accelerate their implementation in Canada.

BACKGROUND

The problems being faced by the universities in training HQM, and maintaining their research capacity have been identified by MOSST and by NSERC on a number of recent occasions.

Cabinet approved, subject to availability of funding, a proposal for an Industrial Postgraduate Scholarship program, administered by NSERC, which would provide for shared funding by industry and government of graduate scholarships for upgrading the qualifications of industrial research personnel and continuing students in fields of study identified by industry.

The CEIC Interdepartmental Skill Development Leave Task Force is in the process of preparing a background paper on paid educational leave which will contain background information on the Canadian situation and the situation for skill development of employees, and the cost of impact of various options for promoting greater use of educational leave for upgrading personnel. Paid educational leave is an important mechanism for meeting critical manpower shortages in

industry, with the full support of industry.

MOSST is developing approaches to strengthening the Centres of Advanced Technology to assure industrial participation in postgraduate training and core research in support of the technology.

The OECD working group on the industry/ university interface has examined a number of initiatives in Canada and elsewhere, which indicate that both the universities and Canadian industry have begun to seek closer ties and that conditions are propitious for a sharper and more focussed development of this interface.

THE U.S. EXPERIENCE

In the U.S., there have been a large number of initiatives taken in recent years to address the problem of increasing industrial involvement in education, in engineering, computer science and related fields. In general, federal involvement has been restricted to two main initiatives:

- two tax provisions contained in the Tax Recovery Act of 1981: one aimed at stimulating industry support for university research; the other at providing a new deduction for industries that make contributions of research equipment to universities; and

- the NSF has developed several programs which

provide start-up funds for cooperative research centres on a matching basis with industry, and for cost-sharing joint industry/university research projects.

The tax provisions appear to be having minimal results in the U.S., largely due to the restrictions and limitations placed on claiming the benefits. The research tax credit, (up to 25% of qualified increased expenditures) for example, has been assessed by a spokesman for the General Electric Company as leading to a very small increase in industry funded university research. The difference in the incentive for increased support of university research as compared to in-house work is negligible in the view of the company. Moreover, this tax credit provision expires in 1985. The amount of the increase in sponsored university research is limited for tax purposes to 65% of the amount actually paid by the firm for basic research at the universities. (Basic research is regarded as any original investigation for the advancement of scientific knowledge not having a scientific commercial objective.)

The research equipment donations incentive is similarly hamstrung. It has been assessed as resulting in increased giving, although it is not expected to have a significant impact on the critical shortage of state-of-the-art equipment available for university research. The reason is that the provision has a narrow scope. Under the provision, corporations that contribute new equipment may deduct the tax cost of the equipment plus 50% of the margin normally realizable upon sale of the

equipment. Further, the equipment must have been manufactured by the donor corporation within two years of the donation and cannot contain purchased parts accounting for more than 50% of the tax costs. It is thought that this provision is a step in the right direction, however, and could lead to a considerable impact on the problem if it was improved to include:

- the fair market value of a computer system, and the related software which is presently excluded;

- purchased component parts of a product where the donor has specified the attributes of the part or has physically modified the part in a proprietary manner; and

- the contribution of used state-of-the-art equipment for research and training purposes.

The NSF shared cost programs have been successful by all accounts, but funding from the agency is limited. Significant developments include:

- The cooperative research project program which requires industry and university researchers to jointly propose and manage a research project is very popular, and peer-group approved but unfunded projects greatly exceed the available funding of about $5 million per year.

- The cooperative research centres have been

expanded from 3 four years ago, to 8 currently. Two of the original three centres did not succeed: one at North Carolina State University, for research in furniture production (a fragmented and small industry), and the other at Mitre Corporation, for research on technology for New England's electric utilities industry (the required scale of research was too big to be done out-of-house). The newer centres are doing well, however, and the attributes of success seem to be much clearer: these include the full backing of the host university, dynamic management, a well-planned strategy that involves full industry participation and direction, and the continuing support of a small core group of companies who have a long term interest in research manpower, and state-of-the-art research in the technology involved. Examples include computer graphics, robotics, polymers, welding, materials science, etc.

In the U.S., as well, there have been a large number of private initiatives. Some are working, some are not doing so well. The widely heralded calls last year of the Semiconductor Industries Association and the American Electronics Association for their members to pledge a portion of either sales (1/10%) or R&D expenditures (2%) for the support of universities has not been successful. It seems that the overlap of membership between these two associations is very large, that there was no specific focus or plan for the fund

other than general salary and equipment support, and that industrial sponsors prefer to focus their support at centres or universities where expertise exists, and where they can reap a direct benefit in people and research results.

Consequently, the Semiconductor Industry Association has established, during the summer of 1982, an independent Semiconductor Research Cooperative (SRC), which is being financed by American semiconductor manufacturers. It will be a clearinghouse for companies interested in sponsoring basic electronics research at universities. IBM originally proposed this idea, but it now has the support of nearly every major manufacturer and user of semiconductor components in the U.S. It is expected to disburse \$6 million in the first year, rising to \$30 to \$35 million by 1985 - about three times the support provided by NSF for microelectronics and computer science. Corporations that join SRC will contribute amounts based on their worldwide sales or purchases of semiconductors. In return they receive research progress reports, and access to royalty-free licenses that arise from the research programs. Research funds will be disbursed to the universities for general research support at "centres of excellence" in priority fields such as computer-aided design and semiconductor materials, for solicited research proposals in specific areas, and for unsolicited proposals. Corporate staff scientists from the sponsoring companies will be working at the major research centres.

Similar cooperatives have been established in other industries - e.g. the Cooperative Automotive Research Program (CARP) sponsored by the Department of Transport and the U.S. automobile manufacturers for basic research on automotive technology for the 1990s; the Stanford University Centre for Integrated Systems (CIS), established with $12 million from industry and $8 million from the Department of Defense; and similar centres at Rensselaer Polytechnic Institute, Massachusetts Institute of Technology and at state universities (with state and industry funds) in Arizona, Minnesota and North Carolina. Carnegie-Mellon and Purdue are attracting substantial corporate investment into work on robotics and industrial automation.

In the area of pure philanthropy, the Exxon Educational Foundation established a $15 million fund in 1982 to be shared by 66 engineering schools. The money is to be used to supplement salaries of younger staff, and to provide fellowships for students to pursue advanced degrees. Exxon continued its concern by hosting a conference at MIT in April 1982 entitled the National Engineering Action Conference. The main result of this conference was a project called the "Engineering College Faculty Shortage Project" which is being funded by nine major corporations. Each of these companies have pledged $100,000 per year for two years to hire a full-time director and operate an office in Washington for the purpose of coordinating efforts to meet the problems of the engineering schools. The project has developed action plans for industry, government and universities, and has an inventory of various

initiatives that have been taken in the U.S.A. to help resolve the problems in engineering education (see Appendix A). Some examples of industry sponsored initiatives are:

- The use of direct financial support to graduate students through traineeships, scholarships and awards. This can be done by allocating a percentage of R&D budgets, payroll, or gross sales to education support.

- Some companies match, either equally or by some multiple, an employee's financial gift to a university.

- Creating opportunities for junior faculty to increase their income through consulting, summer employment, tutorials and grants.

- Entering into arrangements with specific universities to supplement engineering faculty salaries; for example, with grants or endowed chairs.

- Assisting engineering departments to modernize their facilities through financial grants, donation of new or surplus equipment, and innovative debt instruments.

- Actively pursue a policy of purchasing research from universities when appropriate.

- Encourage and provide incentives for qualified employees to teach, part-time or on full-time loan.

THE CANADIAN SITUATION

As the previous discussion makes clear, the problems of the universities have to be widely recognized by industry, and seen as detrimental to the long term interests of industry. This awareness exists now in the U.S. It is not clear that there is a widespread consensus on this question in Canada, either in the universities, the provinces or in industry. Part of the solution, therefore, lies in communicating the problem and arranging for suitable responses. The CCPE Conference on Engineering Education will help, but ultimately it must be up to the universities to initiate action to help solve their resources problems.

The role of government is limited, but it can act as a facilitator of the adjustment process by proposing new directions and initiatives, matching the contributions of industry and the provinces, and participating as a major employer and user of research resources. In this regard, there are several topics which can be considered:

- R&D and other tax provisions

- Use of offsets under procurement arrangements

- Educational Leave

- Departmental sponsorship
- Cooperative research grants
- Cooperative education
- Continuing education

R&D and Tax Provisions

Existing R&D tax provisions permit corporations to receive all of the existing tax benefits (100% write-off, 10% to 20% tax credit and 50% incremental research allowance) for expenditures at an approved university, college or research institute or similar institution for scientific research related to the class of business of the taxpayer. It is also possible to establish a non-profit corporation for scientific research, or an approved association that undertakes scientific research related to the class of business of the taxpayer, and realize all of the existing tax benefits.

The main problem in this area lies in the definition of scientific research in that it does not include scholarships or contributions for research training. Scientific research does, however, include sponsored fellowships related to the class of business of the sponsor, which are awards paid for full-time research; all contract research; salaries of the principal investigators and scientific equipment

required by the research. In principle, therefore, Canadian industry could readily form either:

- A non-profit corporation for scientific research in their class of business, which in turn could sponsor research at approved universities or other similar institutions approved by the Minister of National Revenue; or

- make direct payments for scientific research to approved associations or universities, etc.

The main extensions to existing R&D tax provisions that could be considered would (1) pertain to widening the definition of scientific research to include the words "and research training" in order to specifically permit the sponsorship of scholarships salary supplements for junior faculty, and (2) inclusion of a new provision which would provide a greater incentive for industry to donate scientific equipment, or contribute to a fund for this purpose. As it now stands, industry would receive a 100% write-off of charitable donations to educational institutions for education support or for equipment donations, but no R&D tax credit or research allowance for these expenditures.

Of these two possible changes, the research equipment provision seems the most important. It would appear that industry could sponsor graduate students and junior faculty indirectly by merely increasing its support of university research through contracts,

consultations, research institutes and other mechanisms. It could also employ greater numbers of cooperative program students and help fund the programs of research centres related to their line of business. Equipment donations, however, do not necessarily relate directly to a specific research project but would contribute to the research capacity of a university centre or faculty. State-of-the-Art equipment is becoming increasingly expensive, and would represent in many cases a major financial commitment by the sponsor. Universities are also concerned about the ongoing maintenance and operating costs of major equipment resources. IBM Canada, for example, has made major computer equipment donations to Waterloo University and Ryerson, including provisions for the maintenance and operation of these installations. This firm has large resources, however, and many of our most innovative Canadian companies cannot afford such financial commitments without indirect compensation such as through R&D tax benefits.

It should be considered, therefore, that specific tax provisions be implemented to allow:

- donation of scientific research equipment (new or old) and related software at market value, with a tax credit benefit of 25% of the direct cost, (or depreciated book value of used equipment) to the donor corporation; and

- a continuing tax credit benefit of 10% of the payments made in support of the maintenance and operation of the equipment at an approved

educational institution or research institute.

Offsets

The offset benefits in major procurements, such as the purchase of the F-18 fighter plane and the frigate program, could to an important degree consist of industry arrangements with universities. This could cover both research projects and research training.

Educational Leave

As previously discussed, an interdepartmental task force is developing a background paper on educational leave policy, outlining alternatives for further consideration by the National Advisory Council on Educational Leave. Also mentioned was the approved NSERC IPGS program which provides for matching federal contributions to industry sponsored employees who return for advanced degrees. The maximum NSERC contribution has been established at the value of a regular PGS award (currently $10,500).

Since educational leave is such a significant mechanism for upgrading key staff in management, science and engineering, and since the requirements in these areas will be pressing over the next decade, consideration should be given to providing additional incentives for industry to sponsor this form of leave.

The main area in need of additional attention is part-time education, and specialized courses and

programs at the graduate level. There is a need, we believe, to assist industry and the universities to develop educational programs that meet the needs of industry, and are sensitive to the pressures of part-time students. For example, the main barriers to part-time education, as revealed in surveys, is the time factor - the courses must be scheduled at convenient times, the laboratories made available, and qualified faculty provided. Too often, the problem lies at the door of the universities. University courses are designed in the main for full-time day students; casual staff are used to teach night courses; the laboratories are closed on weekends, and the equipment available is out-of-date for industrial purposes. Clearly, there are limits to what the federal government can do in this area, but it can provide assistance through grants to universities to develop educational programs to meet specific industrial needs, and it can assist in deferring the costs of industrial participants by sharing in the costs of operating the program. These contributions on the part of the federal government should be made on a direct basis, and based on joint funding by industry.

Departmental Support

The line departments can assist the development of research capacity and training by entering into cooperative sponsorship with industry of major research centres at universities, by employing more cooperative students, by developing policies on scientific personnel development and upgrading, and by focussing university

research contracts and support to build specific centres of excellence at Canadian universities. In general, these approaches are being taken by the line departments, and no substantial changes are suggested.

Cooperative Research Projects

The NSF university/industry cooperative research projects program has demonstrated that there is a very large demand in industry for basic research directed at fundamental scientific and engineering problems. The Science and Engineering Research Council in the U.K. has a similar program called the SERC Cooperative Grants Scheme. This SERC program has been so successful after only three years ($9 million in applications per year), that SERC has now made the program an optional form of grant support whenever the industrial contribution to a joint proposal is sufficient to justify the special terms of the scheme. Both of these programs require principal investigators from industry and university to jointly propose a research project for peer review, and to share the work load according to resources and capacity. The actual work may be done in industrial R&D labs or at a university. The research issues selected in this way have industrial relevance. They are often thorny conceptual and theoretical problems at the very base of a technology, process, or science; and the resolution of the problem might lead to major breakthroughs with commercial relevance.

The lead times achieved by the industrial

participation are significant when a major breakthrough occurs, although most of the projects are neither intended to achieve, nor result in major breakthroughs. As a by-product, however, both sectors benefit from the contact - universities gain an appreciation of industrial R&D needs, and industry has the benefit of the academic bent of mind and approach. Graduate students are trained by the research to work on problems with industrial relevance. In short, the cooperative research program results in good basic research with a potential for industrial spin-offs.

It is recommended, therefore, that NSERC experiment with some elements of the strategic grants program to permit joint industry/university research projects to be peer-reviewed, and when there is scientific merit in the project, that it be funded under this program. The existing strategic areas seem appropriate, although some modification of these areas might be indicated as experience with the program matures.

Cooperative Education

Coop programs are highly rated by students and employers. They also result in a better utilization of university facilities, and provide work experience and income to students. Coop programs are particularly suited to the high demand disciplines of computer science, management and engineering.

Graduate coop programs are very rare in Canada;

only a few programs exist at Waterloo, Sherbrooke and Alberta; for example. Major barriers to the expansion of coop programs in general is the availability of jobs for the students during the work term, and the cost of developing the programs at the universities.

The government could assist in the expansion of graduate coop programs by having the line departments coordinate their requirements for research manpower in specific fields, such as engineering, and help selected universities develop graduate cooperative programs which meet these needs. The assistance could take the form of assuring a specified number of term work positions for the students in the program, for a period of five to ten years.

Continuing Education

There is a growing recognition that professional scientists and engineers must keep abreast of developments in their fields in the face of rapidly changing technologies. MIT has proposed the concept of "Lifelong Cooperative Education", as a way of keeping engineers in tune with the changing environment. The authors of this study concluded that the demand for electrical engineers, for example, cannot be met by replacing "obsolescent" engineers with new graduates. The alternative is better utilization of the available work force through continuing education at the work-place with the active support of employers.

Engineering schools and the neighbouring

industries would collaborate in making off-campus graduate courses at the Master's level available to working engineers through tutored video instruction in small classes.

This concept appears timely and suitable in the Canadian context. Again, the government could assist in the development of such a program in Ottawa, Kitchener-Waterloo, Montreal, Toronto - as a major employer with requirements for HQM personnel. The local high technology industries would have the opportunity to join with the government in developing these programs. Successful programs could be extended to many centres by the use of the tutorial and video technique.

SUMMARY OF RECOMMENDATIONS

The following steps could be taken to increase industrial support of university research and training:

- The government could point out in an information brochure, or in a background paper, the need for greater industrial support of university research, and the R&D tax benefits that are already available to industry. These benefits can be realized by corporations when they increase the level of sponsored university research directly, or through a private non-profit research corporation that sponsors research in their class of business.

- New tax provisions should be implemented to

allow:

- donation of scientific research equipment (new or old) and related software at market value, with a tax credit benefit of 25% of the direct cost, (or depreciated book value of used equipment) to the donor corporation; and

- a continuing tax credit benefit of 10% of the payments made in support of the maintenance and operation of the equipment at an approved educational institution or research institute.

Arrangements should be made to assure that some of the benefits from major provincial effects are consumated at universities, through R&D projects and training.

Educational leave is a major mechanism for upgrading research manpower already employed in industry. The government could provide assistance to universities to develop educational programs to meet specific industrial needs, and it can assist in deferring the costs of industrial participants by sharing in the costs of operating the program. These contributions by the government should be made on a direct basis, and based on joint funding by industry to ensure that the programs have industry support.

In view of the exceptional interest of industry

in participating in cooperative research projects with universities, as evidenced in the U.K. and U.S.A., it is recommended that NSERC experiment with this concept in their strategic grants program. In effect, the door would be opened to permit joint industry/university research proposals to be considered on a project-by-project basis, and be reviewed by the appropriate committee. If the project has scientific merit, and otherwise meets the existing criteria, then the university share of the costs should be funded under the strategic grants programs.

As a major employer of scientific and engineering personnel, the government could assist in the expansion of graduate cooperative education programs in specific fields, and help universities develop new programs in fields in high demand. The assistance should take the form of assuring a specified number of term work positions for a period of five to ten years, based on the combined requirements of the line departments.

Tutored video instruction at the masters level in small classes held at the workplace and in various urban centres represents an innovative approach to upgrading and maintaining the competence of employed engineers and scientists. The government could assist in the development of such programs in key disciplines by working with specific universities and neighbouring high technology industries to prepare courses of study that meet the needs of the industry and the government. Successful programs could be extended to many centres by

the use of the tutorial and video technique and local academic and industrial professionals.

APPENDIX A

Suggested Action Agenda

The following suggested actions can contribute directly to meeting the objectives set forth in the Call to Action. For convenience, the actions are listed by sector — higher education, industry, professional societies and government — but there is obviously a high interrelationship. All the actions listed may not be within the ability or resources of a given organization. However, every organization can undertake some portion of the initiatives. In fact, nearly every example listed has already been implemented in at least one instance.

For Higher Education

1. Increase incentives, rewards and recognition for undergraduate teaching of engineers.
2. Set engineering faculty compensation at a level recognizing realistically the market for such talent in industry.
3. Aggressively recruit promising undergraduate students to enter graduate programs, and strive to make the academic environment attractive to them.
4. Increase graduate student stipends to encourage a larger number of U.S. residents to become doctoral students.
5. Develop a flexible program of industrial residencies for graduate students, which builds on the success of undergraduate cooperative education.
6. Give high priority to modernizing instructional and research equipment and facilities in order to provide the capability for sustaining frontier research and instruction based on current technology.
7. Improve research and instructional productivity by providing adequate staff support.
8. Find creative ways for interested faculty and Ph.D. candidates to do research on subjects that might attract industry involvement.
9. Make greater use of part-time faculty and reconsider the Ph.D. requirement, placing greater reliance on practical skill and knowledge in filling faculty positions, including industry experience.
10. Expand collabrative, problem-focused research with industry and reward faculty for participation in such programs.
11. Enhance the financial autonomy of colleges and departments of engineering, using as a model such professional disciplines as law and medicine.
12. Win support among appropriate constituencies by publicizing the contribution of engineering institutions and the engineering profession.

For Industry

1. Provide direct financial support to U.S. resident masters and doctoral candidates in the form of traineeships, scholarships and awards.

2. Create opportunities for junior faculty to increase their income through consulting, summer employment, tutorials and grants.

3. Enter into arrangements with specific universities to supplement engineering faculty salaries; for example, with grants or endowed professorships and chairs.

4. Assist engineering departments in modernizing their facilities and equipment, through financial grants, donation of new or surplus equipment and innovative debt instruments.

5. Actively pursue opportunities for purchasing research from universities instead of conducting it in-house when appropriate.

6. Enter into innovative programs with universities for cooperative research projects — sharing facilities/equipment/people.

7. Contribute to improving the quality and productivity of engineering education by accepting opportunities to serve on university advisory committees.

8. Encourage and provide incentives for qualified employees to teach in engineering as part-time, loaned or full-time faculty members.

9. Make clear in interactions with Congress, state legislatures, and boards of trustees that industry strongly supports initiatives for increasing engineering Ph.D.'s.

10. Enrich the faculty's experience by carrying on a continuing dialogue about modern engineering practice and emerging technology.

11. Help raise awareness among the general public regarding the importance of engineering to society and the serious problems in engineering education.

For Academic and Professional Societies

1. Using related educational foundations, expand scholarship and fellowship aid to engineering doctoral students and make direct grants to the schools.

2. Encourage their memberships to make financial contributions in support of engineering education and, where possible, take advantage of corporate matching grant programs.

3. Monitor manpower supply/demand in their respective areas of interest in order to help identify activities that will help maintain an adequately prepared supply of graduates and faculty.

4. Establish programs to facilitate engineering personnel exchanges between industry and academia, including a computerized data base that contains basic information on personnel and positions available and formal training programs to prepare industry engineers for teaching assignments.

5. Establish a forum of interested association and industry leaders in which the status of engineering education can be reviewed and discussed at least once each year and appropriate actions planned.

6. Conduct an intensive effort at the national level to encourage expanded graduate fellowship programs in engineering funded by the NSF and mission agencies.

7. Coordinate efforts at the state level, using state societies and local chapters, to increase state support to engineering education for faculty salaries, laboratory facilities and equipment, and financial aid for graduate study.

8. Plan and implement a campaign to alert the public to the state of engineering education nationwide and to the implications of the situation for jobs, productivity and future economic opportunities for themselves and their children.

For State and Federal Government

1. Encourage reexamination of policies, especially at the state level, which may preclude making the pay of engineering faculty, and the educational environment, competitive.

2. Assign priority to studies and hearings to determine the nature and scope of the engineering faculty shortage.

3. Support studies and hearings to identify and establish mechanisms to achieve the proper balance in support for equipment, manpower and other costs within the overall levels of academic research and education.

4. Encourage study for doctorates in engineering by providing fellowships, traineeships, internships and other aid to doctoral candidates under the aegis of the National Science Foundation, the mission agencies, Federal laboratories and other governmental organizations that employ engineers. These should carry adequate stipends to demonstrate the significance placed on higher degrees in engineering.

5. Expand "new investigator" and other programs in Federal agencies which are designed to encourage and support the research of new engineering faculty.

6. Further streamline regulatory and administrative procedures such that Federal and state monies directed toward engineering research and education will receive the most efficient and productive use possible.

7. Expand opportunities for university faculty to participate in government laboratory research.

8. Encourage joint research between industry and engineering faculty.

9. Lend the prestige of government to encourage private efforts to help solve the shortage of engineering faculty and emphasize the importance attached to engineering in our society.

THIS BACKGROUND PAPER IS AVAILABLE FOR REFERENCE AT CANADIAN RESEARCH LIBRARIES IN BOTH OFFICIAL LANGUAGES.

THE REPORT OF THE SKILL DEVELOPMENT LEAVE TASK FORCE, "LEARNING A LIVING IN CANADA", IS GENERALLY DISTRIBUTED. TO RECEIVE COPIES OF THE REPORT, CONTACT:

Enquiries and Distribution
Public Affairs
Employment and Immigration Commission
140 Promenades du Portage
Hull, Québec
K1A 0J9
(819) 994-6313